City of Fremont

2010 Greenhouse Gas Emissions Inventory Update

January 2014

This report was supported by Pacific Gas and Electric Company in collaboration with StopWaste and ICLEI-Local Governments for Sustainability USA.

Pacific Gas and Electric Company provides comprehensive climate planning assistance to local governments, from providing energy usage data and assistance with greenhouse gas inventories, to training and guidance on climate action plans. This program is funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission.

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Executive Summary

The City of Fremont adopted a goal to reduce greenhouse gas emissions to 25% below 2005 by 2020. The City tracks progress toward this goal by conducting periodic inventory updates for interim years and compares them to the baseline and reduction target. This report presents the inventory update for 2010.

Updated methodology, more granular data, and clarified guidance from regional and state entities have become available since 2008 when the original baseline inventory for 2005 was conducted. The same calculation methodology must be applied in order to enable a comparison between 2005 and 2010 inventories. This report presents both inventories using consistent methodology that aligns with the current industry best practices. While any inventory methodology has its limitations, inventories created using consistent methodology do serve as a useful tool for tracking community emissions over time.

The 2010 inventory shows that the City is on track to reach its 2020 goal, with a decrease of about 11% compared to 2005 emissions. The 11% decrease is likely due to a combination of several factors, including: increased efficiency in both buildings and motor vehicles; a decrease in the emissions associated with PG&E's power mix (this can fluctuate from year to year); decreases in energy consumption due to the economic slowdown that was in effect in 2010; and implementation of a variety of strategies laid out in the City's Climate Action Plan.

Current trends suggest that the 2020 target is achievable. The City should continue to monitor overall emissions as well as locally controllable GHG emitting activities, and maintain Climate Action Plan implementation efforts in order to make the 2020 target a reality.

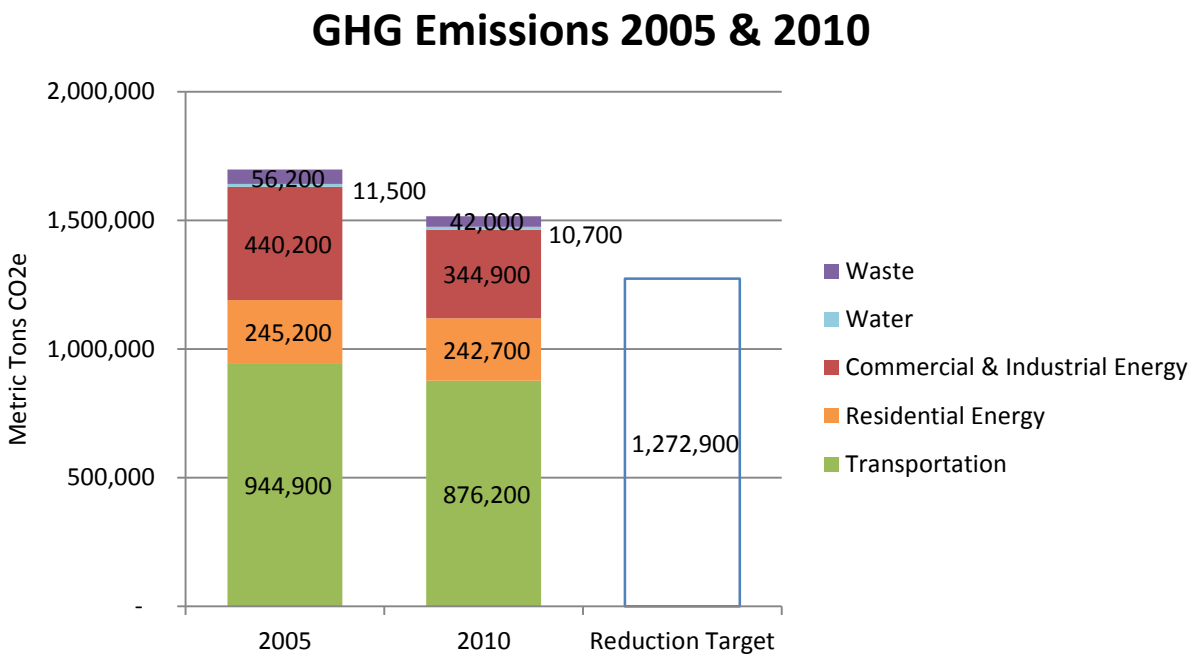

Figure 1. Community Greenhouse Gas Emissions in 2005 and 2010 Compared to Reduction Target

Background

The City of Fremont has committed to playing its part to mitigate climate change by reducing GHG emissions from the community and municipal operations.

City of Fremont's Approach to the Climate Action Plan: Five Milestones

In 2008, the City of Fremont joined ICLEI—Local Governments for Sustainability (formerly named 'International Council for Local Environmental Initiatives'), and agreed to participate in the Alameda County Climate Protection Project. The Climate Protection Project was launched by ICLEI in partnership with StopWaste and the Alameda County Conference of Mayors. In committing to the project, the City of Fremont embarked on an ongoing, coordinated effort to reduce greenhouse gas emissions, improve air quality, reduce waste, cut energy use, and save money.

Similar to other cities in California and across the nation, Fremont's approach to climate action planning is based on ICLEI's 'Five Milestone' process:

Milestone 1: Conduct a baseline greenhouse gas emissions inventory and forecast
Milestone 2: Adopt an emissions reduction target
Milestone 3: Develop a Climate Action Plan for reducing emissions
Milestone 4: Implement policies and measures
Milestone 5: Monitor and verify results

Milestones 1 through 3 are discussed in detail in the City's Climate Action Plan, available on the City's website (www.fremont.gov/climateplan). Since the adoption of the Climate Action Plan, the City and community have engaged in Milestone 4, implementing policies and actions to reduce greenhouse gases. Some successes are described in this report. Milestone 5 is the subject of this update, which offers a perspective on how greenhouse gas emissions have changed since the baseline year and where the City currently measures on the trajectories forecasted toward 2020.

Milestone 1: 2005 Baseline Inventory of Greenhouse Gas Emissions

The purpose of the baseline emissions inventory was to determine the levels of greenhouse gas emissions that the City of Fremont emitted in its base year, 2005, on a municipal operations level and a community-wide level. It is worth noting that calculating emissions with precision is difficult, and the calculations depend on numerous assumptions and are limited by the quantity and quality of available data. Therefore, **it is most useful to think about any specific numbers describing greenhouse gas emissions in the Climate Action Plan as an approximation, rather than an exact value.** These numbers provide a sense of the *magnitude of scale* of the challenge to reduce greenhouse gas emissions which faces the City of Fremont, and of the *opportunities* for the City and community to make a difference and work towards achieving its reduction goals.

Over the years, data availability, accuracy of calculations, and clarity of guidance from regulatory bodies improve. As a consequence, GHG inventory methodology evolves, and local governments benefit from updating their inventories from the baseline and subsequent years. City staff and StopWaste have

hereby updated the 2005 baseline and conducted an inventory for 2010 using currently available methodologies. Appendix A explains the changes to the methodology and the rationale for each change. Future revisions to these inventories may be warranted if there are further improvements to the calculation methodology.

Milestone 2: Adopt an Emissions Reduction Target

The City of Fremont's adopted goal of a 25% reduction in the City's greenhouse gas emissions by 2020 from a 2005 baseline is more ambitious than the State of California's goal. With the adoption of this goal, the Fremont City Council wished to express consistency with the emission reduction goals of other participants in the Alameda County Climate Protection Project and to reflect the City's aspirations for achieving significant reductions in emissions. The City Council has not adopted a longer-term emission reductions goal, such as the 2050 target in AB 32.

Milestone 3: Climate Action Plan

On November 13, 2012 the City Council adopted an ambitious and extensive Climate Action Plan (CAP) that defined strategies to reach the target. The strategies address building energy efficiency, renewable energy, vehicle trips, vehicle fuel efficiency, water conservation, recycling, and green infrastructure.

The City of Fremont's Climate Action Plan is the culmination of efforts beginning in 2008 with work done by the Green Task Force, a City Council-appointed citizen group. The development of the Plan involved the community, elected and appointed officials, other public agencies and private organizations, and staff from several City departments. The Climate Action Plan is consistent with the goals and policies of the City's General Plan (adopted in 2011), and reinforces the principle of sustainability which is the central theme of the General Plan.

Milestone 4: Implementation

Since the adoption of the Climate Action Plan, City staff has been working to implement the strategies in the CAP. The community at large has also begun to adopt new technologies and behaviors that contribute to the reduction of greenhouse gases. An update on progress to date is included in this report.

Milestone 5: Tracking Progress

To measure progress toward achieving the target, GHG inventory updates should be conducted regularly, at least every five years. As noted above, calculation methodologies evolve over time. To enable comparison between years, previously conducted inventories should be brought into alignment with the currently accepted inventory methodologies. This report provides an updated 2005 inventory using the current methodology, and an inventory of 2010 emissions to monitor changes over the five years since the baseline inventory. The more frequently data is made available, the more useful it is for informing the City's progress and feedback on the effectiveness of its efforts. StopWaste is exploring ways to streamline the inventory process in future years to allow for more regular and less burdensome monitoring of progress.

Key Findings from Updated 2005 Baseline Inventory

This report includes an updated 2005 inventory that follows current best practices established by ICLEI and Bay Area Air Quality Management District.[1] The inventory quantifies GHG emissions resulting from community activities in car and truck travel originating or ending in Fremont; energy usage by homes, businesses, and industrial facilities; emissions from treating water and wastewater; and sending waste to landfills.

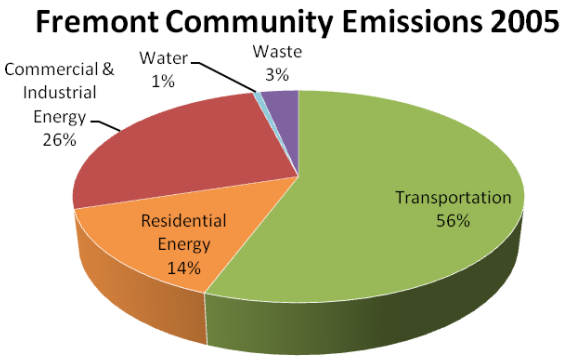

Figure 2. Distribution of 2005 Community Emissions by Sector

2005 Community-Wide Emissions

In 2005, Fremont had about 70,000 households, 210,000 residents, and 90,000 jobs. The updated methodology shows that activities in the Fremont community in 2005 resulted in approximately 1,698,000 metric tons of carbon dioxide equivalent (metric tons CO_2e) of greenhouse gases. This total figure is relatively close (within 3%) to the baseline inventory in the Climate Action Plan (1,660,000 metric tons CO_2e). There are differences within specific sectors, particularly:

- A new methodology of quantifying and attributing vehicle miles to Fremont resulted in slightly lower transportation emissions than in the original inventory. Whereas the original inventory captured all vehicle miles traveled within Fremont's boundaries including all of the pass-through travel on freeways, the new inventory reflects vehicle miles traveled for trips that originate or end in Fremont. This method more accurately reflects the travel activities resulting from Fremont's land use and community member choices.
- Emissions from nonresidential energy usage are slightly higher than in the original inventory due to the inclusion of Direct Access customer data who do not purchase their energy from the utility (PG&E). The energy consumption and related emissions for these customers were not captured in the original inventory.
- A new water sector has been added to account for energy use for upstream treatment and distribution of water consumed, and downstream treatment and methane generation from wastewater generated by the community

Figure 2 above shows the distribution of emissions for both the community-wide sector. The distribution is informative for planning climate action measures, as it shows which sectors generate the greatest emissions and may be considered for targeted programs and policies.

[1] Appendix A contains a detailed description of the new methodology.

2005 Municipal Emissions

City of Fremont (municipal) operations generated approximately 8,820 $MTCO_2e$, or less than 1% of the community's emissions. The municipal inventory figure has changed from the original inventory to include employee commutes, which the City can influence through initiatives to encourage employees to use public transit, walk, bicycle, or carpool.

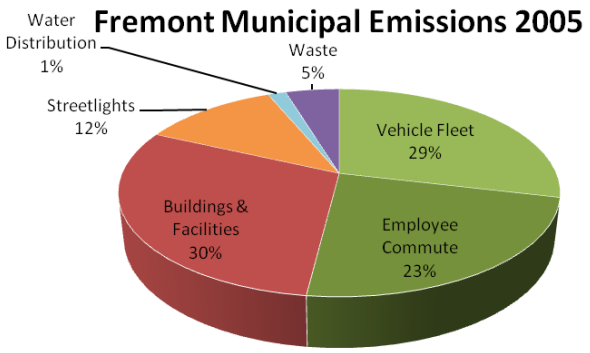

Figure 3. Distribution of 2005 Municipal Emissions by Activity

Municipal emissions are part of the community-level emissions. That is, emissions from the City's vehicle fleet and employee commutes are included in the community's Transportation sector emissions; emissions from energy used by City buildings and facilities, streetlights, and water distribution are included in the community's Commercial and Industrial Energy sector; emissions from waste generated at municipal facilities is included in the community's' Waste sector emissions. Completing separate emissions inventories for community and municipal operations allows the City to set priorities and implement initiatives to lower emissions over which it has a higher degree of control.

Figure 3 demonstrates the distribution of emissions within the municipal sector. By reducing its municipal emissions, the City can show leadership and commitment. At the same time, the City recognizes that over 99% of emissions in the community are not from municipal sources. To address these, the community at large, including other agencies, will need to play an active role in finding and implementing solutions.

Key Findings from 2010 Inventory

2010 emissions were calculated using the same inventory methodology as the updated 2005 inventory.

2010 Community-Wide Emissions

By 2010, Fremont had grown to about 71,000 households and 214,000 residents. During this same time period, however, employment had declined to 86,600 jobs. While an increased population could have resulted in increased emissions for 2010, a decrease in employment may have counteracted this effect. Regardless, the community's activities in 2010 are estimated to have resulted in approximately 1,516,500 metric tons CO_2e, which is a decrease of

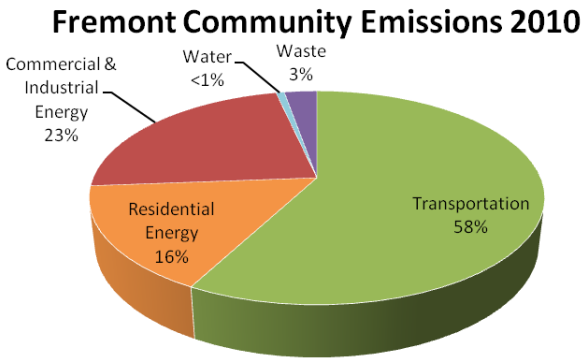

Figure 4. Distribution of 2010 Community Emissions by Sector

approximately 11% – or 181,500 metric tons CO_2e – from the updated 2005 baseline.

2010 Municipal Emissions

In 2010, City of Fremont (municipal) operations generated approximately 8,250 $MTCO_2e$, approximately 6% fewer emissions than in 2005.

Figure 4 and Figure 5 show that the distribution of emissions by sector at both the community-wide and municipal levels is similar in many respects to the distribution in 2005.

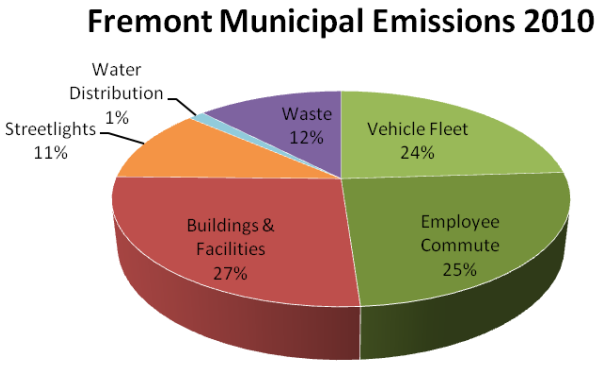

Figure 5. Distribution of 2010 Municipal Emissions by Activity

Additional Sectors for Future Inventories

It is important to note that a few sectors were evaluated in the 2010 inventory process, but were ultimately excluded from the overall inventory for the following reasons. Some sectors were excluded due to a lack of reliable data or calculation methodology for 2010, or an inability to replicate the calculation methodology in a meaningful way for the 2005 baseline year. Others were excluded because they overlapped with sectors already included in the inventory and their inclusion would have therefore caused double counting.

Additional sectors excluded from the 2010 inventory, as well as the reason why they were excluded, are highlighted below:

- Off-road vehicle fuel consumption, freight rail, and passenger rail were estimated for 2010, but could not be estimated for the baseline year using consistent methodology.
- Water-related energy usage farther upstream than ACWD treatment was estimated for 2010 but data was currently unavailable to estimate the same for 2005.
- Industrial point source emissions were collected, but would require additional analysis to avoid double-counting with the nonresidential energy sector.

These and potentially other sectors may be considered for inclusion in future inventories if data or improved methodologies become available. Appendix B discusses the analysis done for 2010, and provides guidance on data needed to include them in future updates.

2010 Emissions Compared to 2020 Projection and Target

Each time the baseline inventory is updated to align with evolving methodologies, the 2020 GHG emissions target and projection values *in metric tons* should also be updated. The GHG reduction target as a *percentage* of the baseline will not change, and the 2020 business-as-usual projection as *percentage* over the baseline will only change if the growth projection methodology is updated.

Because the total emissions using the new methodology fall within 3% of the original baseline inventory included in the Climate Action Plan, the values in metric tons for the reduction target and business-as-usual projections also remain relatively consistent with those in the Climate Action Plan.

The Climate Action Plan projects that in a business-as-usual scenario, 2005 level emissions would increase by 19.2% by the year 2020. In that growth scenario, 2010 emissions levels would have been 1,806,700 metric tons CO_2e. The Climate Action Plan reduction target requires emissions to be 25% below the 2005 baseline by the year 2020. In a linear trajectory toward the target, 2010 emissions levels should have been 1,556,500 metric tons CO_2e. Figure 6 shows that in the current inventory update, the 1,516,500 metric tons CO_2e for 2010 is in fact slightly below the trajectory toward the 2020 reduction target.

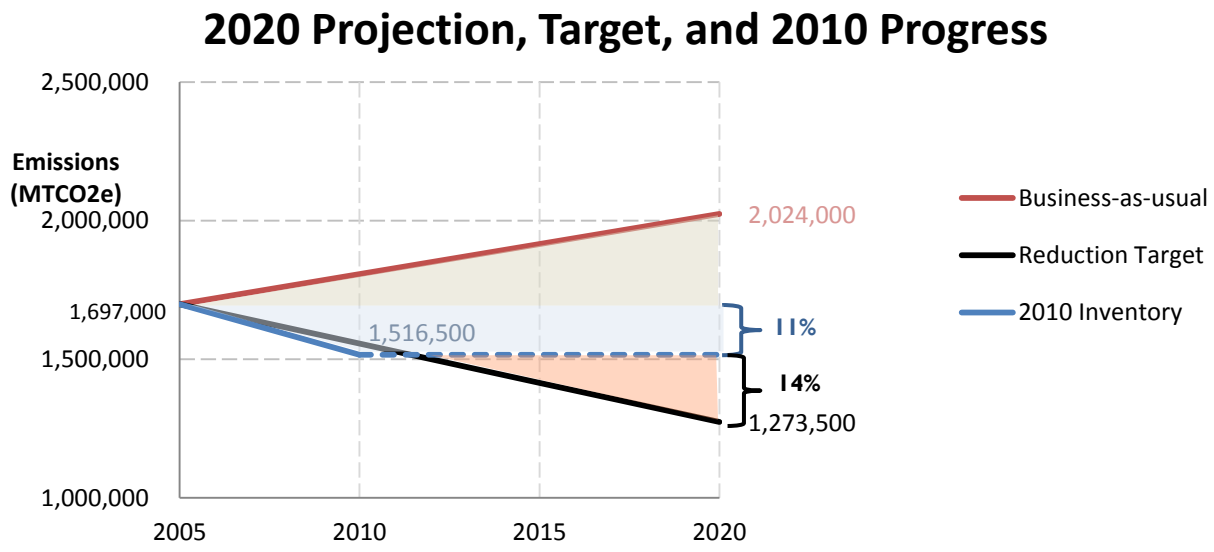

Figure 6. 2010 Community Emissions Compared to Linear Trajectories toward 2020 Business-as-usual Projections and Reduction Target

Important Considerations for Comparing Emissions

Emissions estimates are a function of several variables. Some of these are within the City and community's control or sphere of influence. Others, such as economic conditions and weather patterns, are far beyond local control. In most cases, the volume of emissions generating activity (e.g. energy used or miles driven) is within local control while emissions factors (e.g. PG&E's energy mix) are farther

beyond local influence. It is important to recognize which factors the City and community can affect, and to focus on monitoring their increases and decreases.

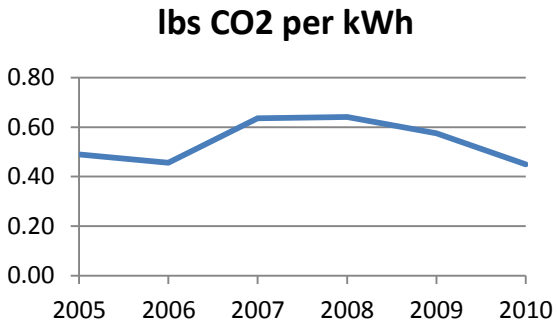

Figure 7. PG&E Electricity Emissions Factor 2005 - 2010

While Fremont's 2010 emissions are estimated to be 11% lower than its 2005 emissions, it is important to note that some of the factors contributing to the decrease are cyclical in nature. One key variable that accounts for a large portion of the observed decrease is PG&E's electricity emissions factor. PG&E's energy mix included a higher percentage of non-emitting sources (primarily large hydroelectric sources due to greater rainfall and water availability) in 2010 compared to 2005. This change alone accounts for about 32,000 of the total 181,500 metric tons CO_2e reduction.

Figure 7 shows the emissions factor fluctuation between 2005 and 2010. While Renewable Portfolio Standards should cause emissions factors to continue to decrease, it is possible that drier years could result in hydroelectric sources being replaced by natural gas generation and consequently a higher emissions factor. Comparing actual usage figures (such as Mbtu of energy usage or gallons of H_20 consumed) and reviewing trends between 2005 and 2010, then, may help to clarify whether emissions have been reduced specifically as a result of a change in activity, as a result of a change in emissions factors, or as a combination of the two.

In addition to considerations around PG&E's emissions factor, it is important to recall that economic activity was relatively low in 2010 due to the recession, resulting in reduced emissions from the commercial and industrial sectors compared to a more typical year. As the economic situation improves and community activity increases, emissions would be expected to increase as well. It is therefore extremely important for Fremont to move ahead with implementing the Climate Action Plan to continue to make progress toward meeting its emission reduction goals regardless of these outside variables.

Changes in Emissions by Sector

In Fremont, emissions have decreased by varying degrees in every sector between 2005 and 2010, as shown in Figure 8. Emissions in the transportation, nonresidential energy, and waste sectors decreased by the largest percentages from the 2005 baseline. Because these sectors are sensitive to economic dynamics, the observed decrease in related emissions may be (at least in part) a reflection of the effects of the economic recession.

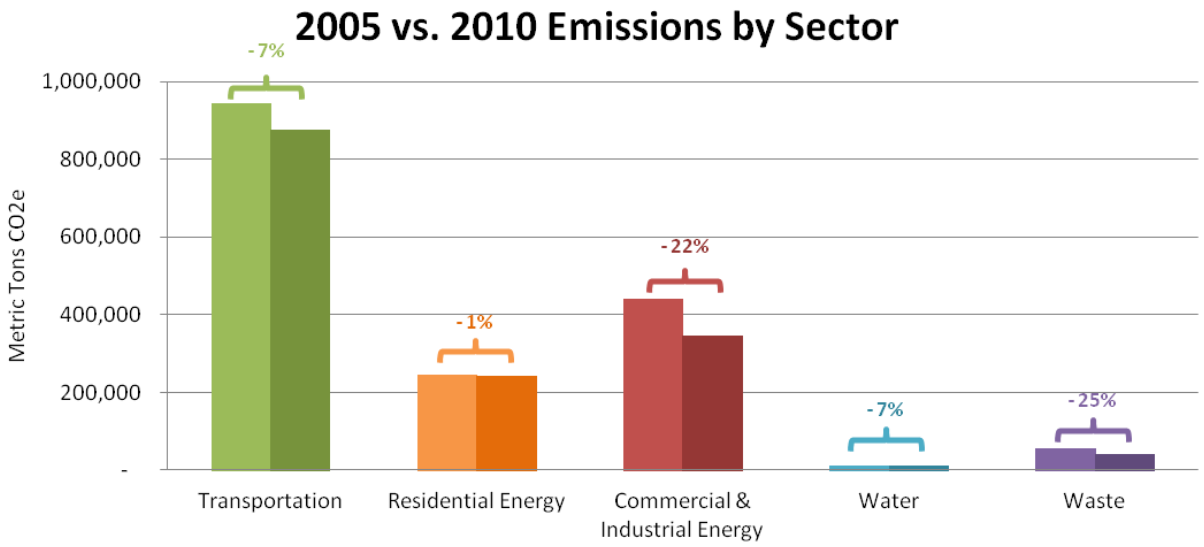

Figure 8. Comparison of 2005 and 2010 Community Emissions by Sector

Transportation

Overall emissions from the transportation sector in 2010 were 7% lower than in 2005.

The emissions attributed to the transportation sector are those caused by the consumption of gasoline, diesel, and other fuels by vehicles trips that start or end in Fremont.[2] Passenger vehicle trips account for the majority of transportation emissions (64% in 2005 and 67% in 2010). Figure 9 shows the breakdown of transportation emissions between 2005 and 2010, demonstrating that passenger vehicle emissions decreased by 4% and commercial truck emissions decreased by 13%.

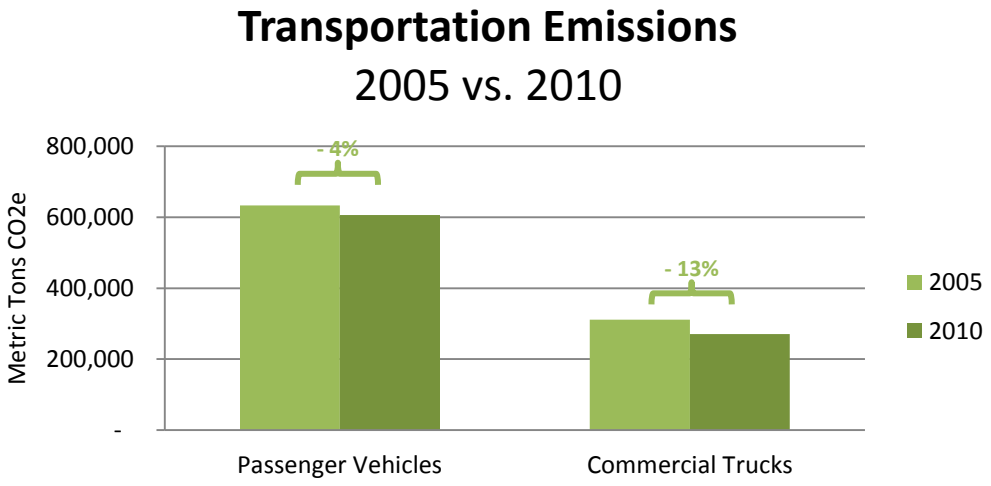

Figure 9. Transportation Emissions by Vehicle Type Comparing 2005 and 2010 Emissions

[2] See Appendix A for a detailed explanation on the estimation methodology for vehicle trip volume and lengths.

Decreases in transportation emissions may be conservative estimates, however, because the methodology and available data may not fully capture the gains in fuel economy observed between 2005 and 2010. This is due to the limitations with the regional modeling software for fuel economies, which only reflects regulatory drivers and not changes in the market for preference toward higher fuel economy vehicles.[3]

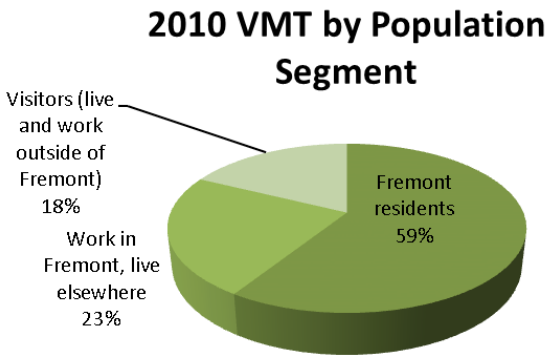

Figure 10. 2010 Passenger Vehicle Miles Traveled Attributed to Fremont, by Population Segment

Accordingly, changes in vehicle emissions observed in this report are primarily a function of changes in vehicle-miles traveled (VMT). The decrease in vehicle miles traveled by passenger vehicle can be attributed to changes in trip distances and patterns, which are significantly influenced by where people live and work. Figure 10 shows that Fremont residents are responsible for more than half (59%) of the passenger VMT attributable to Fremont. The remainder is driven by non-residents who work in Fremont (23%) and visitors who neither work nor live in Fremont (18%). Such a distribution is similar to 2005.

In 2010, 5% fewer Fremont residents commuted outside of the community for work, 5% more residents were non-working, and 3% fewer people commuted into Fremont from other communities than in 2005. At the same time, 8% more residents worked within Fremont's city limits. Localizing the workforce means shorter trips and therefore a reduction in vehicle miles traveled.

Commercial vehicle VMT dropped 12%. This is a function of total regional commercial vehicle VMT, and the number of freight-related jobs in Fremont, both of which decreased due to reduced economic activity. County-wide commercial vehicle VMT decreased by 7% while freight related jobs in Fremont decreased by 13%. Commercial vehicle activity and its corresponding emissions is driven by economic activity. The reduction in emissions from this source can likely be attributed to the economic recession.

Residential Energy Usage

Overall emissions from the residential energy usage sector in 2010 were 1% lower than in 2005.

Residents generate GHG emissions when they consume electricity and natural gas in their homes. Natural gas consumption accounts for a greater portion of residential emissions (61% in 2005 and 64% in 2010) than electricity consumption. Figure 11 shows that between 2005 and 2010, electricity emissions actually decreased by 9% while natural gas emissions on the other hand increased by 4%.

[3] At this time, the best data available for fuel efficiency at the local level is based on growth projections over a baseline year (2009) and *does not* precisely reflect actual vehicle mix on the road in any given year (see Appendix A for more detail). It is likely that the recent trends favoring more fuel efficient vehicles would result in a lower emissions factor per mile than is reflected here. At the same time, fewer turnovers due to the economic recession may result in an aging vehicle fleet that becomes less efficient and cause more emissions. National data (e.g. http://www.epa.gov/fueleconomy/fetrends/1975-2012/420r13001.pdf, page 6) suggests a significant increase in fuel economy between 2005 and 2010.

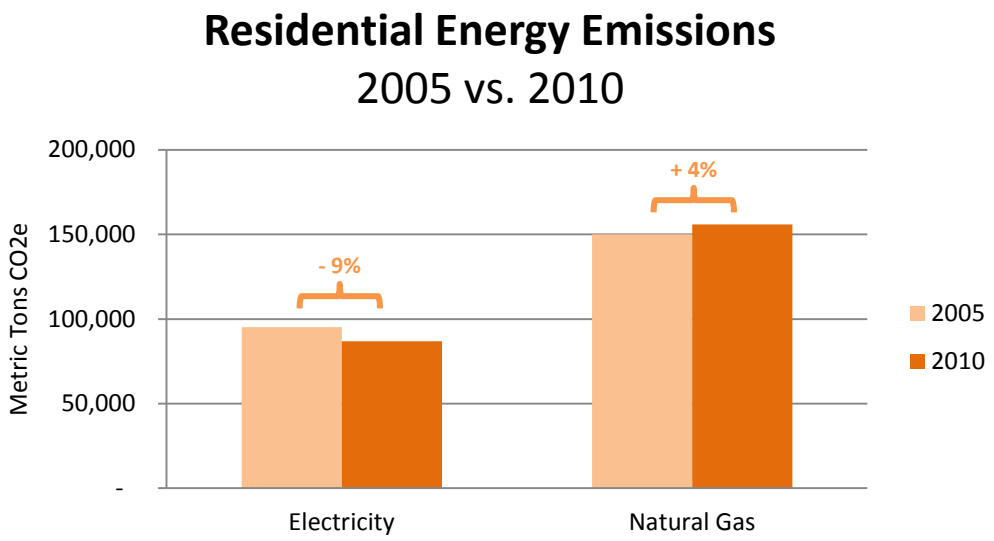

Figure 11. Comparison of Residential Energy Emissions by Fuel Type

Even with such differences in emissions, overall, the residential sector consumed about the same electricity in 2010 as it did in 2005. The observed reduction in emissions in the residential sector is therefore primarily a function of PG&E's lowered emissions factor. It is important to keep in mind that this is a variable that is outside of local influence and could indeed fluctuate in the opposite direction in future years (such as in the case of a drought year where non-emitting hydroelectric energy is more scarce). The community should continue to pursue residential electricity use reductions to compensate for potential emission factor increases in the future.

Considering the 2% growth in population between 2005 and 2010, *per capita energy usage* remained relatively consistent between 2005 and 2010, with per capita electricity usage decreasing by 1% and per capita natural gas usage increasing by 2%. A relevant external variable to consider when looking at these usage patterns is annual temperature. *Heating degree days* are an indicator how much heating is required to maintain a comfortable indoor temperature, with the inverse being *cooling degree days*.[4] In 2010, heating degree days in the region were 29% higher than in 2005, which may explain an increased need for natural gas for heating. Cooling degree days were relatively the same (3% less than in 2005) and would not help to explain any difference in cooling load electricity.

Although there is an increase in energy usage compared to 2005, 2010 consumption was slightly lower than interim years as shown in Figure 12. This trend continues in 2011 and 2012. If the trend continues in future years, the next greenhouse gas inventory update will reflect this reduction.

[4] Heating and cooling degree day data obtained from www.weatherdatadepot.com for weather station FMXX in Fremont, using 60 deg Fahrenheit as the balance point.

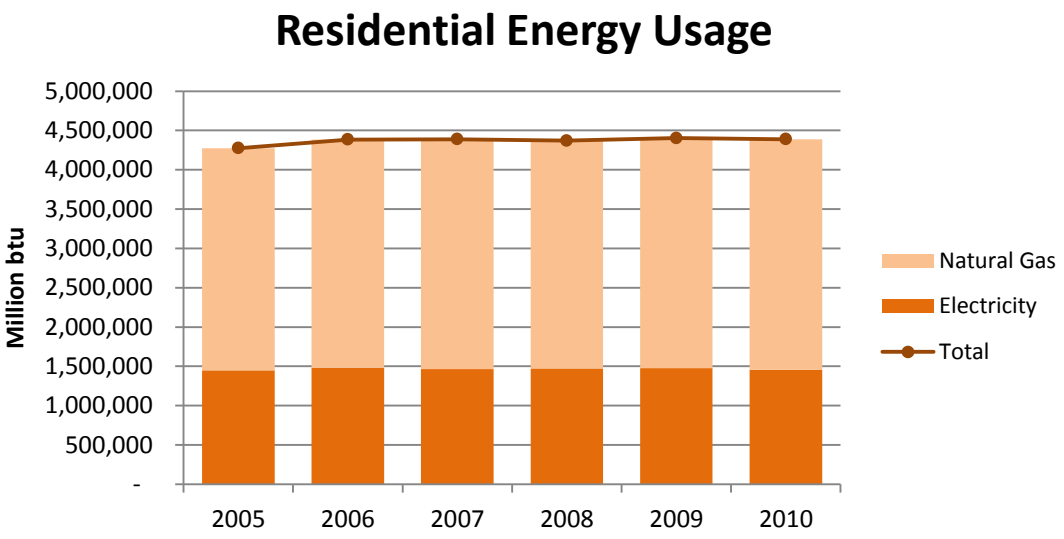

Figure 12. Residential Energy Usage 2005 to 2010

Nonresidential Energy Usage

Overall emissions from the nonresidential energy usage sector in 2010 are 22% lower than in 2005.

Similar to the residential sector, the nonresidential sector (commercial, institutional, industrial) generates GHG emissions through electricity and natural gas usage. Opposite of the residential sector, *electricity use* accounts for a greater portion of emissions (56% in 2005 and 70% in 2010) than natural gas use. Figure 13 shows that between 2005 and 2010, electricity emissions decreased by 15% and natural gas emissions decreased by 32%.

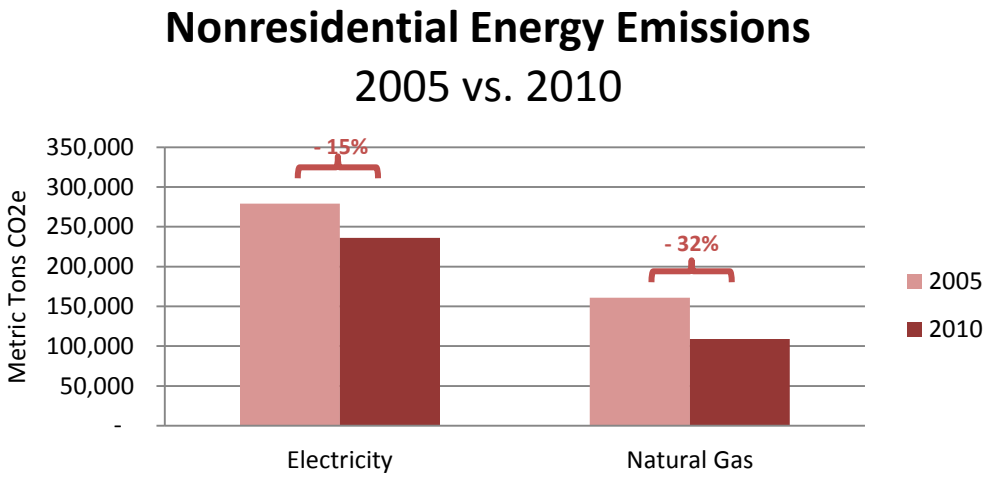

Figure 13. Comparison of Non-residential Energy Emissions by Fuel Type

The non-residential sector used 7% less electricity and 32% less natural gas in 2010 than in 2005. The current inventory applies the standard PG&E energy mix to calculate the emissions from nonresidential

electricity[5], which translated the 7% decrease in usage into a 15% decrease in related emissions. As Figure 14 shows, this decreased reflects a trend between 2005 and 2010.

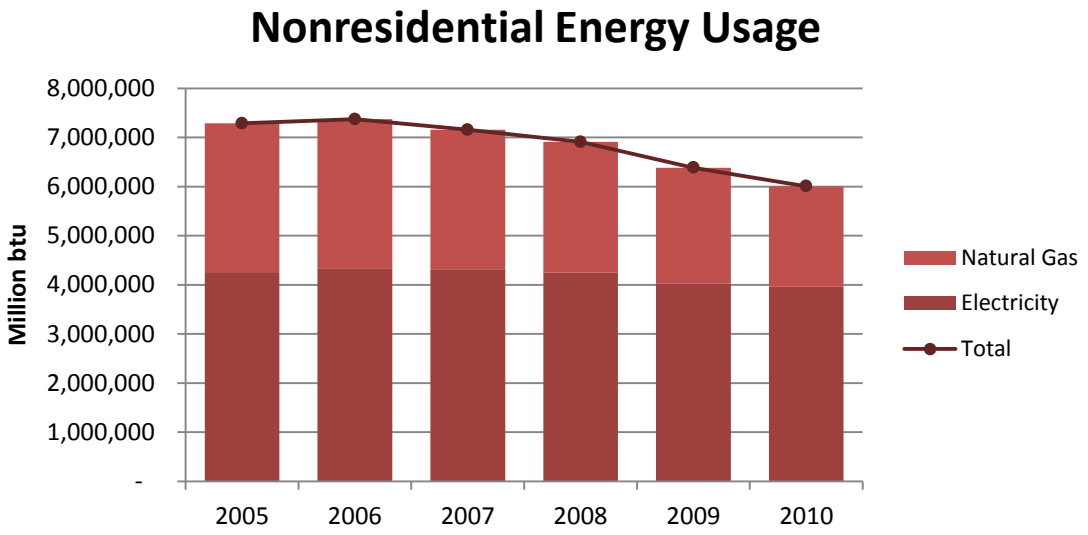

Figure 14. Nonresidential Energy Usage 2005 to 2010

The decreased energy usage is likely caused primarily by the economic recession. In 2010, employment in Fremont was 4% lower than in 2005, and several energy-intensive (and particularly natural-gas intensive) facilities were not operating. The Climate Action Plan anticipated growth in the nonresidential sector, and designed the GHG reduction measures to address growth. As Fremont's commercial and industrial sectors rebound economically, energy efficiency and renewable energy will prove important to place increasing emphasis on if GHG reduction targets are to be met. Such a strategy will allow Fremont to enjoy the benefits of economic growth while at the same time reducing its impact on the environment.

Water

Overall emissions from the water sector in 2010 are 7% lower than in 2005.

Water use generates emissions during its upstream and downstream treatment and transportation, including energy use and methane gas escaping from wastewater (sewage) systems.[6] Increase in

[5] Some industrial facilities obtain their electricity from sources other than PG&E, called Direct Access. Because PG&E cannot disclose the percentage or emissions that come from Direct Access customers to allow a different emissions factor to be applied to them, this inventory uses the PG&E validated emissions factor for all nonresidential electricity usage. See Appendix A for further discussion on nonresidential energy usage data.

[6] The current inventory limits upstream energy use considerations to ACWD facilities due to data availability. Future inventory refinements may consider including energy usage to source and convey the water to ACWD. Union Sanitary District (USD) energy consumption included in this sector is limited to the allocation for Fremont by population (excludes Union City and Newark). However, ACWD's energy usage is also included in the nonresidential energy emissions sector. The amount of emissions that may be double counted is de minimum (less than 0.5%).

population necessarily results in an increase in wastewater generated and the organic material that produces nitrous oxide. These nitrous oxide emissions increased 2% as a function of population. Per capita water consumption, the energy used by Alameda County Water District (ACWD) to treat the water upstream, and the emissions factor of that energy all declined between 2005 and 2010, collectively resulting in 20% less emissions caused by ACWD's water treatment processes.

ACWD offers incentive programs and other resources to reduce water consumption by the community. Particularly in drought years, the community is called upon to limit water use and find ways to save water through efficiency measures and conservation practices. As a result of such efforts (at least in part), per capita water consumption in ACWD decreased by 17% between 2005 and 2010.

A lower electricity emissions factor also allowed emissions from Union Sanitary District's energy used to treat *wastewater* downstream to remain relatively constant while treated volume increased. Therefore, total water-related emissions decreased by 7% even as population has grown.

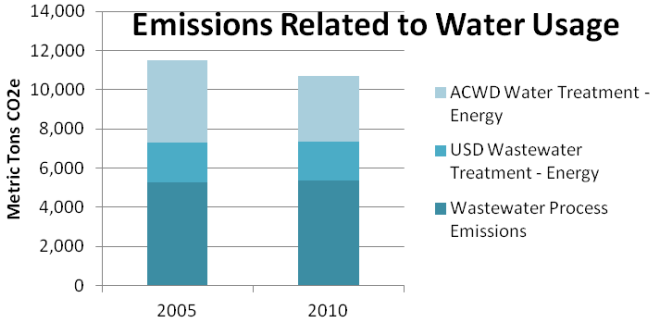

Figure 15. Emissions Quantified in the Water Section, by Emission Type/Source

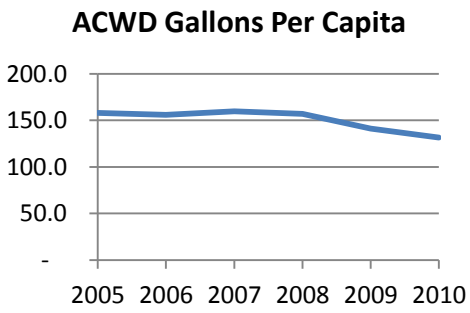

Figure 16. ACWD Systemwide Water Consumption Trends 2005 - 2010

Waste

Overall emissions from the waste sector in 2010 are 25% lower than in 2005.

This reduction is a function of 30% less volume of waste sent to landfill and the changing composition of the waste stream. Waste sector emissions are the methane emissions that are produced from organic materials decomposing in the landfill over time. Keeping organic materials such as plant debris, paper and food out of landfills is the best way to reduce the amount of methane generated at landfills.

Between 2005 and 2010, the City of Fremont undertook numerous efforts to reduce the amount of waste sent to the landfill by focusing efforts on green waste. These efforts are summarized below:

- 2005 was the first full year of the commercial organics program, at which time there were 26 participants. By 2010, the program had grown to 55 businesses and 13 City facilities.
- In 2010, residents diverted over 28,000 tons of green waste and food scraps, up from 26,000 tons in 2005.
- Commercial and industrial accounts diverted over 4000 tons of green organic material in 2010, an increase of almost 400 tons from 2005.

Furthermore, in 2009 the Alameda County Plant Debris Landfill ban went into effect, requiring that green waste be separated from other waste so it can be composted, not landfilled. These measures and continued growth of the organics programs continue to move Fremont closer to achieving its goals.

Municipal Operations Emissions

Overall emissions from municipal operations in 2010 are 6% lower than in 2005.

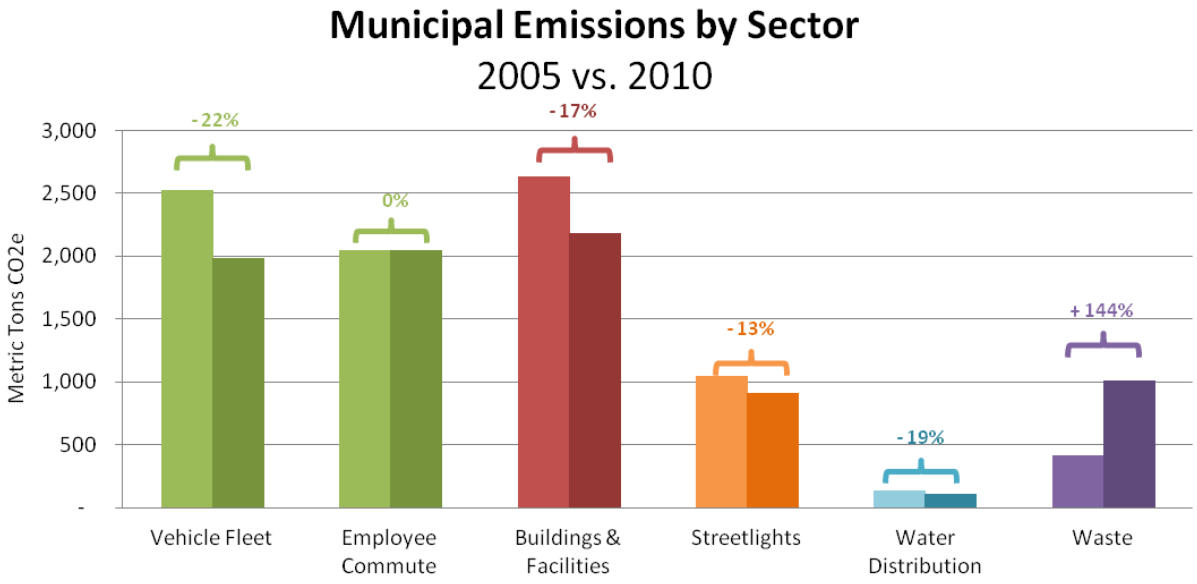

Figure 17 shows the difference in Municipal emissions by sector between 2005 and 2010. Energy and fuel usage for the vehicle fleet, buildings and facilities, streetlights, and irrigation/water distribution all decreased, while waste generation at municipal facilities increased.

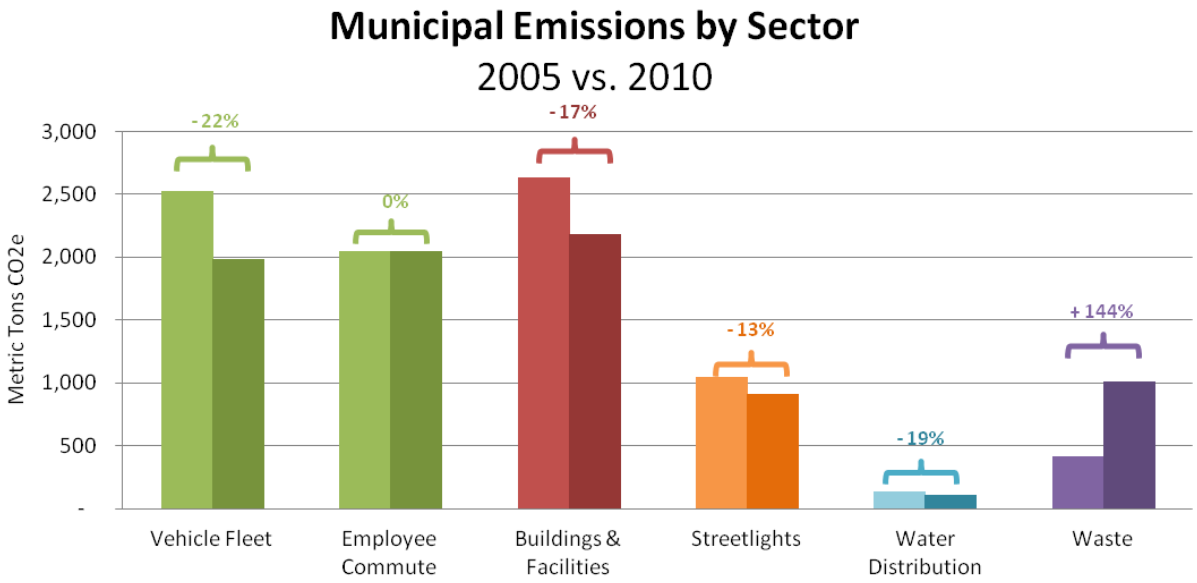

Figure 17. Comparison of Local Government Municipal Operations Emissions by Activity Type

Possible explanations for changes in Municipal emissions in each sector are provided below:

- **Vehicle Fleet:** A decrease in emissions related to vehicle fleet can be attributed to the replacement of conventional gasoline and diesel-powered vehicles with natural gas and hybrid electric vehicles. As aging fleet vehicles continue to be replaced with alternative fuel vehicles (especially plug-in electric), emissions from vehicle fleet should continue to decrease.
- **Employee Commute:** Emissions attributable to employee commutes was not quantified and included in the 2005 municipal inventory. Best practice recommends that this activity be captured. In 2010, employee commute emissions were estimated through a questionnaire survey of the commute patterns of 10% of employees working in the main City buildings. Because it would be infeasible to replicate the same survey for 2005 employees, the 2010 estimates are used as the emissions value for this activity in both 2005 and 2010. It is important to add a value in 2005 (even though using the 2010 value is imperfect) to allow for the total municipal inventory amounts to be meaningfully comparable between 2005 and 2010.
- **Buildings & Facilities:** A decrease in emissions from buildings and facilities can in part be attributed to energy efficiency upgrades.
- **Streetlights:** The conversion of at least 5% of City streetlights on a number of major thoroughfares from high pressure sodium to LED fixtures accounts for the reduction of emissions related to streetlights, and is anticipated to continue to drop as the City converts the remainder of its streetlights to LEDs.
- **Water Distribution:** A reduction in emissions resulting from water usage can be attributed to water conservation strategies in City parks, even with the opening of the Fremont Aqua Adventure Park in May of 2009.
- **Waste:** An increase in emissions from the waste sector is likely caused by the addition of new City facilities including a few Fire Stations, a Police Firing Range, a Fire Department Training Center and the Aqua Adventure Water Park, which tend to generate higher volumes of waste compared to other City facilities. The difference may also reflect differences in reporting methodology by the waste hauler or waste processing facilities and landfills which changed between 2005 and 2010.

2005 to 2010 and Beyond: Activities and Successes to Date

Total emissions estimates are a function of many variables as discussed in the previous section and in Appendix A. Therefore the emissions figures calculated are not necessarily a perfect indicator of the impact of successful programs and initiatives implemented in the community. However, in the time between the baseline year of 2005 and the adoption of the Climate Action Plan in the fall of 2012, City staff has been actively engaging the community in GHG reducing initiatives. The Climate Action Plan describes many of the initiatives that had been undertaken through 2010. A significant amount of activity has occurred since 2010 that would not yet be reflected in the Climate Action Plan nor the 2010 GHG inventory update.

Examples of recent and ongoing City initiatives that will contribute to GHG emission reductions in future inventories include:

- Conversion of remaining city streetlights to LED technologies (ongoing)
- Promoting the use of renewable energy through code revisions and streamlined permitting
- Collaboration with PG&E to promote energy efficiency upgrades in businesses and residences
- Land use changes focusing new growth near transit, thereby reducing average VMT

Furthermore, with the hire of a full time staff person to oversee the implementation of the Climate Action plan and the appointment of an Environmental Sustainability Commission to update the City Council on Climate Action progress and recommend new actions, the City of Fremont has demonstrated its increasing commitment to reducing greenhouse gas emissions in both municipal operations and the community at large. The benefits of these recent developments may be reflected in future GHG inventory updates.

Conclusion

The Fremont community has made measurable progress toward reaching the City's 2020 GHG reduction target. The overall emissions decrease of 11% reflects changes in multiple variables. Some of these factors are external to the community's activities, such as the utility's power mix and the resulting emissions factor. Such fluctuations will affect inventories each year, but are beyond local control. The City and community have more direct control and responsibility over the volume of GHG-causing activities, such as energy used and miles driven. Between 2005 and 2010, almost all of these activities decreased or stayed relatively consistent. It is important for the City to continue to track ongoing local greenhouse gas emitting activities in addition to completing regular GHG inventories to identify successes as well as areas for future improvement within sectors that the local community can control.

In future years, Fremont may benefit from regional efforts to streamline the inventory process. Ideally, information will be readily and regularly accessible so that meaningful updates may be presented closer to real time. As inventory methodology and data availability improve, future inventory updates should continue to revisit the baseline and other past inventories to make them consistent with best practices as they emerge.

Appendix A – Methodology

Community-level greenhouse gas (GHG) inventory methodology is an established yet evolving field. As data accuracy and accessibility improve, methodologies work to incorporate them with the goal of creating meaningful inventories for policy makers and the public. When methodology is updated or new data sources become available, it is important to update previous years' inventories to maintain consistency. This is necessary if different years' inventories are to be compared to each other to find trends and track progress over time.

BAAQMD GHG Plan Level Guidance

In May 2012, the Bay Area Air Quality Management District (BAAQMD) issued guidance for local governments developing community-scale GHG emissions inventories. The guidance document was presented as a recommended approach rather than a formal protocol, and will be continually updated as new tools, methodologies and protocols are developed and refined. The Air District reviews plans for CEQA compliance, and therefore it is advantageous to align with their recommendations. The guidance document outlines basic parameters for sectors to include and calculation methodology.

- Sectors to include:
    - Residential – electricity and natural gas
    - Commercial/Industrial – electricity and natural gas
    - Transportation – fuel consumption
    - Waste – landfill gas
    - Water Treatment – electricity
- Emissions should be expressed in metric tons CO_2e and use emissions factors found in the California Air Resources Board's Local Government Operations Protocol.

The updated 2005 and 2010 inventories hereby provided align with these recommendations. Future inventory updates should follow this same protocol and include any forthcoming recommendations from BAAQMD.

Compliance with ICLEI's U.S. Community Protocol

In October 2012, ICLEI – Local Governments for Sustainability (ICLEI) published the first national standard for community-level inventories. It formalizes a body of study and practice that local governments have been advancing over the past several years, and provides detailed guidance on calculating and reporting GHG emissions at a community level. Fremont's current 2010 inventory is compliant with the ICLEI U.S. Community Protocol because it satisfies the following requirements:

- Contains an Emissions Report Summary Table (within Appendix A) that illustrates emissions included and excluded from the inventory and presents emissions in CO_2e
- Includes quantified estimates of emissions associated with the five Basic Emissions Generating Activities
    - Use of Electricity by the Community
    - Use of Fuel in Residential and Commercial Stationary Combustion Equipment

    - On-Road Passenger and Freight Motor Vehicle Travel
    - Use of Energy in Potable Water and Wastewater Treatment and Distribution
    - Generation of Solid Waste by the Community
- Include data for each emissions source or activity on a line item basis, and for each include:
    - Activity data
    - Emissions factors used (with source)
    - Emissions in CO_2e
    - Accounting method used
- Include community context data (at least total population and households in the inventory year)

The ICLEI Community Protocol recommends several valid frameworks for structuring and reporting GHG emissions. The current inventory uses the *activity-based method* which quantifies GHG emissions that occur as a result of activities by the community in each of the categories listed above. This method was selected because it offers the most meaningful information for local policies and programs. Alternative frameworks include a *source-based method* which quantifies the emissions that physically occur within the City's boundaries. This method would count emissions that occurred locally but were caused by people outside of the community, such as pass-through traffic, and would also miss significant emissions associated with activities such as electricity and water consumption where generation occurs outside of the boundaries. In past inventories, local governments often combined pieces of activity-based and source-based methodologies, resulting in potential double-counting of emissions and the need to classify emissions by Scopes[7] which have little value from a local community initiative or policy-making perspective.

An emerging inventory methodology described in the ICLEI Community Protocol attempts to quantify additional *"upstream" emissions* related to the sourcing, manufacturing, and transporting of goods and services consumed by the community. This extends the rationale of including electricity generation and water treatment emissions in the activity-based methodology to apply to other goods. The current challenge is the extremely limited data available for quantifying these emissions. As data sources and the quantification methodology improve, Fremont may wish to consider including upstream emissions in future inventory updates.

Fremont's Current Inventory Updates

Several methodology updates were applied to 2005 and 2010 data. The key differences from the original baseline inventory methodology are:

[7] Previous unofficial community protocols, and current protocols for other industries, utilized three Scopes to distinguish emissions types. Scope 1 contained all emissions generated as direct activity of the entity within the entity's geographic boundary or direct financial or operational control (e.g. on-site combustion of natural gas). Scope 2 contained indirect or off-site emissions caused by activities within the entity's geographic boundary or direct financial or operational control (e.g. emissions from electricity generated in a distant county but consumed on-site). Scope 3 captured all other indirect emissions, including emissions that would occur in a delayed manner (e.g. methane emissions from organic materials the entity sent to landfills). The Scopes are designed to prevent multiple entities from counting the same emissions source within the same Scope.

- **The volume of passenger vehicle miles driven is derived from activity-based models** that account for the mileage generated by trips originating or ending in the jurisdiction, instead of estimations of the miles driven within the jurisdictional boundaries regardless of the trip start or end points. This method more accurately reflects the travel activities resulting from Fremont's land use and community member choices, and is aligned with ICLEI's recommended activity-based framework.
- **Water sector emissions were added to the inventory** per the ICLEI and BAAQMD guidelines. Emissions included were those related to energy use for upstream treatment and distribution of water consumed, and downstream treatment and methane generation from wastewater generated by the community.
- **Local government inventory includes employee commute**, estimated based on employee survey responses.

Community Activities and Emissions Factors

Table A.1 provides line item details of community-level emissions in CO_2e, emissions factors, and activity data for each sector. In each sector, emissions are a product of multiplying a volume of activity (e.g. kWh of electricity consumed) by an emissions factor (e.g. CO_2e per kWh purchased from PG&E). The emissions factors in the table are expressed in CO_2e, which includes carbon dioxide (Global Warming Potential = 1), methane (GWP = 21) and nitrous oxide (GWP = 310). The following data were used for each sector.

Transportation. The Metropolitan Transportation Commission (MTC) generated an activity-based model for Fremont using the *Travel One model*. This model reports average daily miles traveled by six population segments that travel to or within Fremont over a year, and for three trip types: Entirely within Fremont, partially in Fremont, and entirely outside of Fremont. The total vehicle miles included in the inventory is a sum of 100% of "entirely within" trips and 50% of "partially in". MTC provided the emissions factors based on the *Emissions Factors (EMFAC) model* reflecting county-level fuel efficiencies and emission trends.

MTC generated a Travel One model report for county-level vehicle miles traveled by trucks. The data is unavailable at the city level. US Census employment data were for jobs in industries that generate high numbers of truck trips were used to distribute the truck VMT to each city within the county. The job categories included in this are Agriculture, Forestry, Fishing and Hunting; Mining, Quarrying, and Oil and Gas Extraction; Utilities; Construction; Manufacturing; Wholesale Trade; Retail Trade; Transportation and Warehousing. Fremont was estimated to have 45,000 and 39,000 such jobs in 2005 and 2010 respectively, using U.S. Census data and North American Industry Classification System (NAICS) codes. This represents about 17% of these jobs in the county and thus the truck VMT included in the inventory. MTC provided the emissions factors for trucks using the EMFAC model.

The EMFAC is a tool from the California Air Resources Board. It calculates emissions rates based on a baseline year (2009 for the current version of EMFAC). The baseline year emissions are a function of 1) inventory the state's vehicle stock, 2) measured emissions of a sample of vehicles representative of

types in the inventory, and 3) VMT and speed data generated by the various metropolitan planning organizations (MPOs; MTC is the organization for the Bay Area). Emissions data for other years are calculated using growth projections in the turnover rate of vehicles by year, and VMT and speed data generated for those years by the MPOs. In calculating the fuel efficiency of the vehicle stock, EMFAC can take into account the impacts of regulations (such as the Low Carbon Fuel Standard and Pavley legislation). It also makes assumptions about the rate of vehicle turnover – or the retiring of older vehicles (which lose efficiency and have higher emissions rates as they deteriorate) and replacement by new vehicles. In the most recent version, EMFAC takes into account impacts of the recession on purchasing of new vehicles, and therefore a relative aging in the overall vehicle stock. It does not, however, take into account any voluntary trends toward higher fuel efficiency standards. As a result, the EMFAC emissions factors are likely higher than what the actual vehicle fleet may be producing.

The following emissions factors for CH4 and N2O were for each vehicle type, and were constant between the 2005 and 2010 inventories. The percentage assumed mix of the vehicle fleet for each year is also shown below.

Vehicle Type	2005 % VMT	2010 % VMT	N2O - grams per mile	CH4 - grams per mile
Passenger Vehicles				
Automobiles - Gasoline	55%	57%	0.0294	0.0278
Automobiles - Diesel	0.3%	0.2%	0.0010	0.0005
Light Trucks - Gasoline	1.5%	1.3%	0.0433	0.0315
Light Trucks - Diesel	42%	41%	0.0015	0.0010
Trucks & Buses - Gasoline	0.3%	0.3%	0.1235	0.1031
Trucks & Buses - Diesel	0.6%	0.7%	0.0051	0.0048
Commercial Vehicles				
Diesel	70%	70%	0.0051	0.0048
Gasoline	30%	30%	0.1235	0.1031

Built Environment – Residential and Non-Residential Electricity and Natural Gas. PG&E provided total kWh and therms used by each sector. The 2005 data given during the baseline inventory and 2005 data given to the City in an updated Green Communities report conflicted. PG&E advises cities to use the most recent data available, so the 2005 baseline data have been updated in this inventory. The most noticeable sector and fuel is non-residential electricity usage. A comparison between the original baseline inventory and updated baseline energy usage cited in this report is presented below for reference.

The new data is derived from the Green Communities report. This data includes energy usage by all nonresidential users, including those with Direct Access accounts that purchase energy from third party vendors that still use PG&E's transmission infrastructure. These accounts were excluded from PG&E's Greenhouse Gas inventory energy usage reports. While some communities choose to use the Greenhouse Gas energy usage reports because they are relatively reflective of the community's total

energy usage, Fremont's report excluded up to 30% of 2005 nonresidential electricity usage compared to the Green Communities report. To more accurately reflect the actual energy usage in the community, Fremont has chosen to use the Green Communities report data.

Sector & Fuel Type	2005 Inventory	Updated Inventory
Residential		
KWH	424,669,962	425,053,014
THMS	28,263,975	28,243,795
Non-Residential		
KWH	878,219,385	1,247,319,590
THMS	30,441,073	30,308,842

PG&E provided the electricity emissions factor for carbon dioxide across their portfolio, which they submit to California Climate Action Registry (CCAR) for verification. Methane and nitrous oxide emissions factors were derived from the California grid average. In reality, the emissions factor for Direct Access should be calculated separately from PG&E customers, because the energy mix from the third party vendors differs from PG&E's portfolio of energy purchases. However, the granularity of data is unavailable to determine what proportion of the total energy use in the Green Communities report is from Direct Access customers versus PG&E customers. For simplicity, the PG&E emissions factor was applied to all electricity usage. In the future, it may be possible to determine the proportion of Direct Access and apply a different emissions factor (either EPA's eGrid average or other more specific emissions factors if they are available).

The natural gas emissions factor is a constant number provided by PG&E as well as ICLEI and other reporting protocols.

Waste. Allies Waste Services provided the total tonnage of landfill waste. StopWaste's waste characterization studies for 2003 and 2008 provided percentages of the waste stream represented by each organic material type, which was applied to the total tonnage. Environmental Protection Agency (EPA) Waste Reduction Model (WARM) emissions factors were embedded in the Clean Air and Climate Protection (CACP) tool and applied to the tonnage for each material type. The methane recovery factor assumed is 75% in both years, based on EPA's AP 42 Emissions Factors, Solid Waste Disposal (pp. 2, 4-6), 1998.

Water. Alameda County Water District (ACWD) provided the total gallons of water consumed and energy usage of their water treatment facilities (in kWh and therms). The gallons of water consumed and related energy usage were distributed to each of the three cities served by ACWD (Fremont, Newark, and Union City) based upon population. ACWD uses the eGrid emissions factors for the relevant years were applied to the kWh usage.

Wastewater treatment emissions consist of energy used for treatment and the methane released from the organic material in the wastewater. Total energy usage was provided by Union Sanitary District

(USD) and allocated to each of the three cities based upon population. Methane emissions from their wastewater treatment facility were calculated based on population using a formula provided by ICLEI.

Municipal Activities and Emissions Factors

Table A.2 provides the same line item details for emission from municipal operations.

Vehicle Fleet. Gallons and vehicle miles traveled were reported by City staff and coefficients from the CACP tool were used to calculate emissions. City staff provided data by department, which would allow for more detailed analysis.

Employee Commute. City staff conducted a survey of a 10% sample of employees working in the main City buildings (*n=84*). The findings were extrapolated to represent all employees. The survey collected data on vehicle type, fuel economy, distance traveled, and frequency of trips. The extrapolated data were entered into CACP to generate emissions totals.

Buildings & Facilities, Streetlights, Water Distribution. PG&E provided the electricity and natural gas usage data for all meters paid by the City of Fremont. These were categorized based on the rate schedules, business activity type, address, or other indicators available into categories of buildings and facilities, streetlights and traffic signals, or water distribution and irrigation. The 2005 baseline inventory was based on similar analysis. A comparison of the total energy usage by category between the 2005 baseline and the 2010 data revealed inconsistencies. The 2005 raw meter data was compared to the 2010 raw meter data and matching meters were assigned consistent categories. This resulted in a change in the 2005 energy usage totals and emissions by category, and an analysis that provides meaningful comparisons between 2005 and 2010.

Waste. The City obtains waste tonnage data from the waste haulers, processing facilities and landfills. The total tonnage was assigned to material types using the following percentage distribution provided the City staff for the 2005 baseline. There is no distribution data more current for the municipal facilities' waste stream.

Paper products	13.4%
Food Waste	1.4%
Yard Waste	20.4%
Wood, textile waste	9.4%
All other types	55.4%

Environmental Protection Agency (EPA) Waste Reduction Model (WARM) emissions factors were embedded in the Clean Air and Climate Protection (CACP) tool and applied to the tonnage for each material type. The methane recovery factor assumed is 75% in both years, based on EPA's AP 42 Emissions Factors, Solid Waste Disposal (pp. 2, 4-6), 1998.

Emissions Summary Report

Table A.3 identifies which sectors are included or excluded in this inventory. This table is a requirement for ICLEI protocol compliant inventories. It identifies which sectors are included in this inventory and

what ICLEI-recommended quantification methodology is used. It also identifies which sectors are excluded from the inventory and why. The full table of sectors addressed is provided by ICLEI and represents the sectors ICLEI considers appropriate for inclusion in a community-level inventory.

Glossary of Sources

ABAG – Association of Bay Area Governments

ACWD – Alameda County Water District

ACWMA – Alameda County Waste Management Authority

AW – Allied Waste

BAAQMD – Bay Area Air Quality Management District

CACP – Clean Air and Climate Protection software from ICLEI

CARB – California Air Resources Board

CCAR – California Climate Action Registry

EBMUD – East Bay Municipal Utility District

EF – Emissions Factor

EMFAC – Emissions Factors modeling software from CARB

ICLEI – Local Governments for Sustainability

LGOP – Local Government Operations Protocol

MTC – Metropolitan Transportation Commission

PG&E – Pacific Gas and Electric

Table A.1: Activities and Emissions Factors

Sector	Activity Data 2005	Activity Data 2010	Emissions Factor(s) 2005				Emissions Factor(s) 2010				Emissions (MTCO2e) 2005	Emissions (MTCO2e) 2010	Source
			CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e			
Transportation													
On-Road Passenger Vehicles	1,508,189,073 VMT	1,453,472,168 VMT	407.33 grams/mile	See detailed table			404.48 grams/mile	See detailed table			633,342	605,646	A
On-Road Freight	379,396,651 VMT	334,666,572 VMT	1,310 grams/mile				1,289 grams/mile				311,523	270,563	B
Built Environment													
Fuel – Residential	28,243,795 Therms	29,306,806 Therms	11.69 lbs/Therm	0.005 kg/mmbtu	0.0001 kg/mmbtu	11.72 lbs/Therm	11.69 lbs/Therm	0.005 kg/mmbtu	0.0001 kg/mmbtu	11.72 lbs/Therm	150,147	155,798	C
Fuel – Nonresidential	30,308,842 Therms	20,495,817 Therms	11.69 lbs/Therm	0.005 kg/mmbtu	0.0001 kg/mmbtu	11.72 lbs/Therm	11.69 lbs/Therm	0.005 kg/mmbtu	0.0001 kg/mmbtu	11.72 lbs/Therm	161,125	108,958	
Electricity – Residential	425,053,014 kWh	427,076,951 kWh	0.4890 lbs/kWh	0.03 lbs/MWh	0.01 lbs/MWh	0.493 lbs/kWh	0.445 lbs/kWh	0.03 lbs/MWh	0.01 lbs/MWh	0.449 lbs/kWh	95,089	86,918	
Electricity – Nonresidential	1,247,319,590 kWh	1,159,362,791 kWh	0.4890 lbs/kWh	0.03 lbs/MWh	0.01 lbs/MWh	0.493 lbs/kWh	0.445 lbs/kWh	0.03 lbs/MWh	0.01 lbs/MWh	0.449 lbs/kWh	279,040	235,951	
Waste													
Paper Products	43,448 Tons	29,020 Tons		0.037 MT/ton		0.78 MT/ton		0.037 MT/ton		0.78 MT/ton	33,712	22,517	D
Food Waste	21,433 Tons	23,460 Tons		0.021 MT/ton		0.44 MT/ton		0.021 MT/ton		0.44 MT/ton	9,413	10,304	
Plant Debris	11,599 Tons	8,001 Tons		0.012 MT/ton		0.25 MT/ton		0.012 MT/ton		0.25 MT/ton	2,887	1,991	
Wood/Textiles	37,338 Tons	32,817 Tons		0.013 MT/ton		0.27 MT/ton		0.010 MT/ton		0.22 MT/ton	10,180	7,207	
Other (non-organic)	80,127 Tons	42,173 Tons											
Total Tonnage	193,964	135,470									56,192	42,018	
Water													
Upstream Energy	12,111 million gallons	10,273 million gallons											E
	12,613,272 kWh	11,052,024 kWh	0.724 lbs/kWh	0.030 lbs/MWh	0.008 lbs/MWh	0.727 lbs/kWh	0.659 lbs/kWh	0.029 lbs/MWh	0.006 lbs/MWh	0.661 lbs/kWh	4,161	3,315	
	9,381 therms	10,029 therms	11.69 lbs/Therm	0.005 kg/mmbtu	0.0001 kg/mmbtu	11.72 lbs/Therm	11.69 lbs/Therm	0.005 kg/mmbtu	0.0001 kg/mmbtu	11.72 lbs/Therm	50	53	
Downstream Energy	8,979,906 kWh	9,673,908 kWh	0.4890 lbs/kWh	0.03 lbs/MWh	0.011 lbs/MWh	0.493 lbs/kWh	0.445 lbs/kWh	0.03 lbs/MWh	0.011 lbs/MWh	0.449 lbs/kWh	2,009	1,969	F
Process Emissions	210,000 population	214,080 population			0.179 lbs/capita	55.4 lbs/capita			0.179 lbs/capita	55.4 lbs/capita	5,273	5,375	G

Table A.2: Activities and Emissions Factors

Sector	Activity Data 2005	Activity Data 2010	Emissions Factor(s) 2005				Emissions Factor(s) 2010				Emissions (MTCO2e) 2005	Emissions (MTCO2e) 2010	Source
			CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e			
Transportation													
Vehicle Fleet	Data unavailable	217,753 Gallons	Data unavailable				20.1 lbs/gal			20.1 lbs/gal	2,530	1,983	A
		1,764,613 VMT						Varies				9	
Employee Commute	Same as 2010	233,700 Gallons	Same as 2010				19.4 lbs/gal			19.4 lbs/gal	Same as 2010	2,052	B
Automobiles	Same as 2010	4,250,085 VMT						0.028 grams/mile	0.029 grams/mile	9.70 grams/mile		41	
Light Truck	Same as 2010	1,298,441 VMT						0.031 grams/mile	0.043 grams/mile	14.09 grams/mile		18	
Built Environment													
Buildings & Facilities - kWh	6,345,742 kWh	5,814,835 kWh	0.489 lbs/kWh	0.03 lbs/MWh	0.011 lbs/MWh	0.493 lbs/kWh	0.445 lbs/kWh	0.03 lbs/MWh	0.011 lbs/MWh	0.449 lbs/kWh	1,420	1,183	C
Buildings & Facilities - Therms	228,661 Therms	187,503 Therms	11.69 lbs/Therm	0.005 kg/mmbtu	0.0001 kg/mmbtu	11.72 lbs/Therm	11.69 lbs/Therm	0.005 kg/mmbtu	0.0001 kg/mmbtu	11.72 lbs/Therm	1,216	997	
Streetlights	4,680,844 kWh	4,485,362 kWh	0.489 lbs/kWh	0.03 lbs/MWh	0.011 lbs/MWh	0.493 lbs/kWh	0.445 lbs/kWh	0.03 lbs/MWh	0.011 lbs/MWh	0.449 lbs/kWh	1,047	913	
Water Distribution	616,732 kWh	550,845 kWh	0.489 lbs/kWh	0.03 lbs/MWh	0.011 lbs/MWh	0.493 lbs/kWh	0.445 lbs/kWh	0.03 lbs/MWh	0.011 lbs/MWh	0.449 lbs/kWh	138	112	
Waste													
Paper Products	307 Tons	748 Tons		0.037 MT/ton		0.78 MT/ton		0.037 MT/ton		0.78 MT/ton	238	581	D
Food Waste	32 Tons	78 Tons		0.021 MT/ton		0.44 MT/ton		0.021 MT/ton		0.44 MT/ton	14	34	
Plant Debris	466 Tons	1,139 Tons		0.012 MT/ton		0.25 MT/ton		0.012 MT/ton		0.25 MT/ton	116	284	
Wood/Textiles	214 Tons	525 Tons		0.010 MT/ton		0.22 MT/ton		0.010 MT/ton		0.22 MT/ton	47	115	
Other (non-organic)	1,265 Tons	3,094 Tons											
Total Tonnage	2,284	5,585									415	1,014	

Table A.1 Community-level Data Sources:

A. VMT specific to Fremont provided by MTC using Travel One model. CO2 EF provided by MTC from output of a customized run of CARB's EMFAC model. For CH4 and N2O EF's see transportation section in this appendix.
B. VMT for Alameda County provided by MTC. Fremont VMT allocation calculated based upon percentage of county-wide transportation-related jobs present in Fremont. CO2 EF provided by MTC from output of a customized run of CARB's EMFAC model. For CH4 and N2O EF's see transportation section in this appendix.
C. Therms and kWh usage data from PG&E Green Communities Tableau data for years 2005 through 2012. CO2 EF provided by PG&E and verified by CCAR. CH4 and N2O EF's from ICLEI Community Protocol and CARB's LGOP.
D. Total waste tonnage provided by Allied Waste. Distribution by material type calculated using ACWMA's waste characterization studies for 2003 (for 2005) and 2008 (for 2010). EF's from EPA WARM assuming 75% landfill gas capture rate.
E. 2005 and 2010 total gallons, kWh, and therms data from ACWD. Allocation to Fremont based upon population. ACWD energy usage is also captured in the PG&E data for note [C] above. The City has the option to "back out" this energy usage from the "nonresidential" sector to avoid double-counting the emission related to the energy usage. The current table does not back it out to maintain a clean number directly provided by PG&E under note [C] and because ACWD's energy usage is less than 1% of the total nonresidential energy usage.
F. Total kWh provided by USD. Allocation to Fremont based upon population. 2005kWh calculated based upon 2010 per-capita usage applied to 2005 Fremont population. May be updated if USD provides 2005 data. PG&E EF used.
G. Total N2O process emissions calculated using formula provided in ICLEI workbook, based upon population and wastewater treatment conditions identified by USD.

Table A.2 Municipal Operations Data Sources:

A. VMT and gallons of fuel consumed provided by City staff. EF's from CACP.
B. Employee commute survey conducted using 10% response sample for 2010. 2005 data unavailable, so City staff elected to use 2010 as a direct proxy.
C. Therms and kWh usage data from PG&E. CO2 EF provided by PG&E and verified by CCAR. CH4 and N2O EF's from ICLEI Community Protocol and CARB's LGOP.
D. Total waste tonnage provided by Allied Waste. See municipal operations waste section in this appendix for distribution by material type. EF's from EPA WARM assuming 75% landfill gas capture rate.

Table A.3: Emissions Summary Report

Community-wide GHG Emissions Inventory ***Scoping and Reporting Tool - October 2012*** **Emissions Type**		**Source or Activity?**	**Included, Required Activities**	**reporting frameworks**	**Excluded (IE, NA, NO, or NE)**	Emissions (MTCO2e)	Accounting Method (see ICLEI protocol)	**Notes**
Built Environment								
Use of fuel in residential and commercial stationary combustion equipment		Source AND Activity	●	●			BE 1.1	
Industrial stationary combustion sources		Source			NE/IE			Point source emissions data from 2005 and 2010 unavailable; majority likely captured in BE1.1
Electricity	Power generation in the community	Source			NO			
	Use of electricity by the community	Activity	●	●			BE 2.1	
District Heating/ Cooling	District heating/cooling facilities in the community	Source			NE			Data unavailable
	Use of district heating/cooling by the community	Activity			NE			Data unavailable
Industrial process emissions in the community		Source			NE			Point source emissions data specific to process emissions unavailable
Refrigerant leakage in the community		Source			NE			Data unavailable
Transportation and Other Mobile Sources								
On-road Passenger Vehicles	On-road passenger vehicles operating within the community boundary	Source	● or		IE			Using activity-based methodology
	On-road passenger vehicle travel associated with community land uses	Activity	●	●			TR 1.A	
On-road Freight Vehicles	On-road freight and service vehicles operating within the community boundary	Source	● or		IE			Using activity-based methodology
	On-road freight and service vehicle travel associated with community land uses	Activity	●	●			TR 2.A	
On-road transit vehicles operating within the community boundary		Source						
Transit Rail	Transit rail vehicles operating within the community boundary	Source			NE			Attribution methodology under development
	Use of transit rail travel by the community	Activity			NE			
Inter-city passenger rail vehicles operating within the community boundary		Source			NE			
Freight rail vehicles operating within the community boundary		Source			NE			
Marine	Marine vessels operating within the community boundary	Source			NE			Minimal impact
	Use of ferries by the community	Activity			NE			Minimal impact
Off-road surface vehicles and other mobile equipment operating within the community boundary		Source			NE			Estimated for 2010, may be included in future. See Appendix B
Use of air travel by the community		Activity			NE			Insufficient data

Solid Waste								
Solid Waste	Operation of solid waste disposal facilities in the community	Source			NO			
	Generation and disposal of solid waste by the community	Activity	●	●			SW 4	
Water and Wastewater								
Potable Water - Energy Use	Operation of water delivery facilities in the community	Source			IE			Using activity-based methodology; included in BE1.1
	Use of energy associated with use of potable water by the community	Activity	●	●				
Use of energy associated with generation of wastewater by the community		Activity	●	●				
Centralized Wastewater Systems - Process Emissions	Process emissions from operation of wastewater treatment facilities located in the community	Source			NO			
	Process emissions associated with generation of wastewater by the community	Activity		●				
Use of septic systems in the community		Source AND activity			NE			Insufficient data
Agriculture								
Domesticated animal production		Source			NE			Insufficient data
Manure decomposition and treatment		Source			NE			Insufficient data
Upstream Impacts of Community-Wide Activities								
Upstream impacts of fuels used in stationary applications by the community		Activity			NE			Insufficient data available at this time; potentially to be pursued in future inventory updates
Upstream and transmission and distribution (T&D) impacts of purchased electricity used by the community		Activity			NE			
Upstream impacts of fuels used for transportation in trips associated with the community		Activity			NE			
Upstream impacts of fuels used by water and wastewater facilities for water used and wastewater generated within the community boundary		Activity			NE			
Upstream impacts of select materials (concrete, food, paper, carpets, etc.) used by the whole community		Activity			NE			
Independent Consumption-Based Acccounting								
Household Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all households in the community)		Activity			NE			Insufficient data available at this time; potentially to be pursued in future inventory updates
Government Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all governments in the community)		Activity			NE			
Life cycle emissions of community businesses (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all businesses in the community)		Activity			NE			

Reasons for exclusion:

- NO = Not Occurring in this jurisdiction
- NE = Not Estimable based on available data, or effort not justifiable
- IE = Included Elsewhere in the inventory, perhaps under another sector
- NA = Not Applicable if activity occurs in jurisdiction but does not generate emission

Appendix B. Potential Sectors for Future Inventories

Data for several sectors not included in this updated inventory were collected and analyzed during the 2010 update process. They were excluded from the current report for various reasons:

A. Quantification methodology needs refinement
B. Comparable data were unavailable for 2005, therefore not allowing an equivalent comparison
C. Inclusion of the emissions could result in double counting emissions in other sectors if no additional detail is available to identify the overlapping emissions

Off-Road Vehicles

Emissions from off-road vehicles in 2010 were estimated to be 81,247 $MTCO_2e$.

The Off-Road 2007 modeling software offered by ARB was used to estimate these emissions, and can be accessed at http://www.arb.ca.gov/msei/offroad/offroad.htm. This model allows the user to determine on a county-wide basis, the amount of off-road vehicles and equipment that are used, how much fuel they consume, and how much pollution they create. StopWaste ran this model and allocated off-road emissions to each jurisdiction based upon population. The following steps and inputs can be used to recreate the model:

- Download and launch software
  - Enter the following in Tabs:
  - Episode- 2010, Mon-Sun, Annual
  - Reporting- TOG, Report by County, Exhaust
  - Area- County, Alameda
  - Equipment- All
  - Fuel and HP- All Fuel Types, All Horsepowers
  - Data Files- Population
- File Save
- Run Current Scenario File
- Export to Excel file type

In order to include this sector in the GHG inventory, the City should look to rerun these calculations for 2005, and decide whether population is a reasonable method of allocating county-wide emissions to Fremont.

BART

Emissions from Bay Area Rapid Transit (BART) energy use in 2010 attributable to the Fremont community's BART usage were estimated to be 2,111 $MTCO_2e$.

BART provided 2010 ridership and direct emissions data. System-wide emissions were attributed to Alameda based on the length of track in Alameda versus other counties. County-wide emissions were then allocated to each station based upon ridership counts. The emissions per station were then allocated to jurisdictions based upon the population assumed to be using the station. In the case of

Fremont, it was assumed that all Fremont and Newark riders would use the Fremont station. The data points were as follows:

Total Emissions BART System	82,438 $MTCO_2e$	Alameda Co Proportion	50.7% (106 of 209 miles)	Alameda Co Emissions	41,810
Ridership for All Alameda Co Stations	34,596 station exists	Fremont Station Ridership	2,093 station exist	% of Ridership	6%
				Fremont Station Emissions	2,530 *(41,810 x 6%)*
Pop. Served by Fremont Station	256,662 (Fremont + Newark)	Fremont Population	214,089	Fremont % of Pop. Served	83.4%
				Emissions Attributed to Fremont Riders	**2,110** *(2,530 x 83.4%)*

In order to include this sector in the GHG inventory, the City should decide whether to use this methodology, and obtain all relevant data points for 2005 from BART.

Freight & Heavy Rail (ACE and Amtrak)

Emissions from the Altamont Corridor Express (ACE) in 2010 were estimated to be 1,513 $MTCO_2e$ and emissions from Amtrak in 2010 were estimated to be 511 $MTCO_2e$.

Data gathered included total amount of fuel consumed and revenue miles for each operating rail service. GIS or specific information from each agency was used to determine the length of rail within Fremont's boundaries. This methodology is consistent with ICLEI's source-based emissions inventory. The current inventory follows the activity-based protocol.

In order to include this sector in the GHG inventory, the City would need to obtain the following data from the relevant agencies, for both 2005 and 2010:

- Total fuel consumed by, or total emissions from, locomotives
- Total revenue miles traveled (or total track in system)
- Portion of revenue miles traveled in Fremont (or portion of track in Fremont, as assessed by GIS)

Industrial Point Source Emissions

Industrial Point Source Emissions data is available in tons of CO_2e from the Bay Area Air Quality Management District. The reported total was 259,816 metric tons. This data was obtained from the Air District's GHG inventory for base year 2007 conducted in 2010.
http://www.mtc.ca.gov/planning/climate/Bay_Area_Greenhouse_Gas_Emissions_2-10.pdf
Individual stationary sources are listed in the inventory, and all sites located in Fremont were tallied for a total emissions amount.

These emissions were excluded from the current report because the data is from 2007 and not for either 2005 or 2010, and because a majority of these emissions may already be captured in the nonresidential sector. When natural gas is combusted for energy by a large industrial site, the consequent CO_2 emissions are monitored and reported to the Air District. As such, those emissions may be counted both

based on the natural gas consumption reported by PG&E as well as the monitored emissions reported by the Air District. This would result in double-counting a set of these emissions. In order to tease out the data, data would need to show exactly which portion of which facilities' reported point source emissions result from the combustion of natural gas purchased through a utility. This information does not exist or is not available.

Upstream Water-related Energy for Conveyance & Distribution

Alameda County Water District (ACWD) sources its water supply from the State Water Project (SWP) (40%), the San Francisco Public Utilities Commission (SFPUC) (20%), and the Niles Cone Groundwater Basin (40%). There are upstream emissions related to water from SWP and SFPUC. Additionally, ACWD's operations pumping and desalinating of brackish groundwater from Niles Cone are fairly energy intensive. Upstream emissions from SWP and SFPUC were added to total embedded energy using the following energy use intensities:

Water Source	Energy Use Intensity	% of ACWD water supply
State Water Project	3,150 kWh/MG	40%
SFPUC	0 kWh/MG	20%
Niles Cone Groundwater Basin	*Included in ACWD energy usage*	40%

Fremont is assumed to use a proportional amount of ACWD water as its population, compared to Newark and Union City. Upstream water-related energy emissions from the State Water Project can be obtained by multiplying the total million gallons attributed to Fremont by SWP's energy use intensity and an emissions factor (PG&E, eGRID, or other provided by SWP).

In order to calculate the upstream emissions for 2005, the same formulas would apply, and would require obtaining SWP energy use intensity for their operations in 2005.